# Implementation of Repeated Measures ANOVA Model: Examining The Effectiveness of Training Nurses to Treat Tobacco Dependency

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## Introduction to Study & Sample

**Study**: 1 hour training for healthcare professionals on a evidence-based treatment tobacco dependency

**Design**: Pre-post-6 mo. follow-up test on 2 domains. Here Focus here: Knowledge & Attitudes domain.

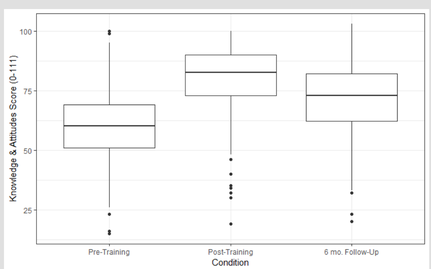
**Sample**: Subset of original study
- Nurses (RN, BSN, APN, NP)
- Completed all portions of assessment at all time points

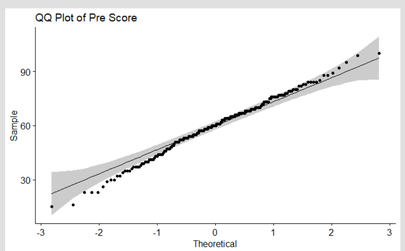
**Assessment**: 11 items each on a scale (0-11);
0="Not at All", 11="Most Possible"
Items summed to create total Knowledge & Attitudes Score.

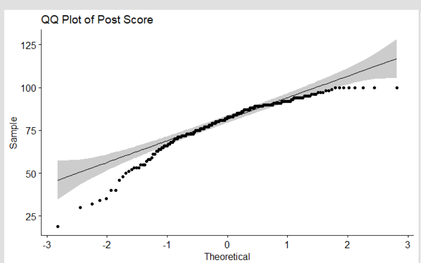
**Example Statement**:
"How much do you know about obtaining reimbursement for the delivery of tobacco cessation interventions?"

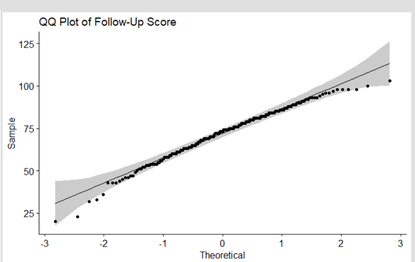
| Participant Characteristics | Nurses (N=206) |
|---|---|
| **Gender** | |
| Female | 89.66 (N=182) |
| **Race** | |
| White | 87.50% (N=175) |
| Black/African American | 9.00% (N=18) |
| Other | 3.50% (N=7) |
| **Age in years** | M=39.14 (SD=12.65) |
| **Tobacco Use Status*** | |
| Never used regularly | 73.10% (N=144) |
| Former user† | 23.35% (N=56) |
| Current user | 3.55% (N=7) |
| **Work Setting** | |
| Academic | 75.78% (N=122) |
| Private Industry | 11.80% (N=19) |
| Other | 12.42% (N=20) |
| **Years Practicing** | M=12.40 (SD=11.90) |
| **Contact with Patients-Yes** | 92.86% (N=65) |
| **Prior Training in Tob. Cessation** | 18.69% (N=37) |

## Exploratory Analysis



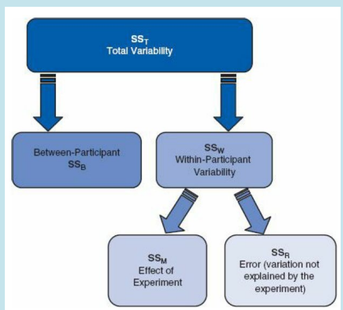




## Research Question

Will a 1-hour tobacco cessation training result in long-term changes in knowledge and attitudes on tobacco cessation for nurses in our sample?

## Model: Repeated Measures ANOVA

### Variability Calculation




$$SS_T = \sum_{i=1}^{N}(x_i - \bar{x}_{grand})^2 \qquad SS_B = SS_T - SS_W$$

$$SS_W = s^2_{person\,1}(n_1 - 1) + s^2_{person\,2}(n_2 - 1) + \ldots + s^2_{person\,n}(n_n - 1)$$

*Taken From: Field, A. P., Miles, J., & Field, Z. (2017). Discovering statistics using R.

### The F Ratio Statistic Calculation

$$SS_M = \sum_{n=1}^{k} n_k(\bar{x}_k - \bar{x}_{grand})^2 \qquad df_M = k - 1$$

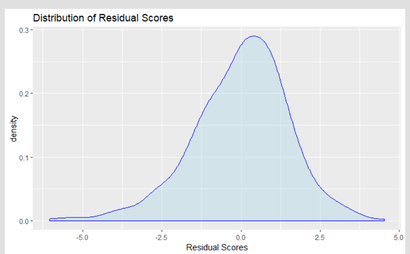
$$SS_R = SS_W - SS_M \qquad df_R = df_W - df_M$$

$$MS_M = \frac{SS_M}{df_M} \qquad MS_R = \frac{SS_R}{df_R} \qquad F = \frac{MS_M}{MS_R}$$

### Assumptions of Model

1. Measured Variable:
   *Continuous Scale*
2. Grouping Variable:
   *3+ categories; within subjects*
2. *Normality of Residuals*
3. *Sphericity*

## Testing Assumptions




**Residuals Explained:**
Observed Value Minus Predicted Value (by Model).

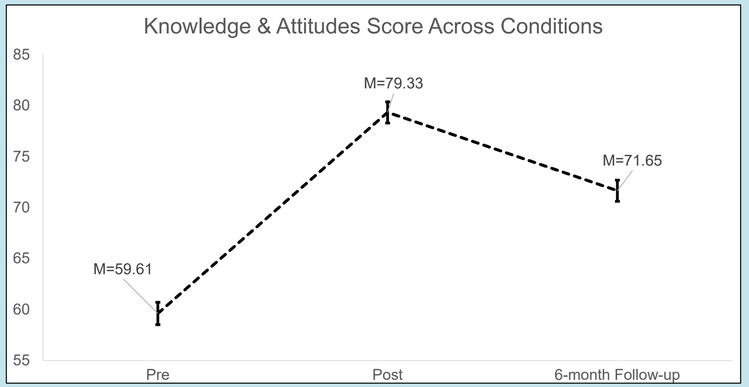
**Sphericity Explained:**
Null: Variance between all possible combinations of levels are equal.

| Mauchly's Test for Sphericity | |
|---|---|
| Effect | 'Condition' |
| W | 0.9469386 |
| p | 0.003844379 |
| p<.05 | '*' |

**Results:**
- Sphericity Violated (see corrections)
- Assumption of Normality-technically violated; but approximate enough

## ANOVA Results

| Effect | dfm | dfr | SSm | SSr | F | p | p<.05 | GES |
|---|---|---|---|---|---|---|---|---|
| Intercept | 1 | 205 | 3044883 | 90763 | 6877 | 1.16e-159 | * | 0.95 |
| Condition | 2 | 410 | 40701 | 51739 | 161 | 2.15e-52 | * | 0.22 |




```
        Pairwise comparisons using t tests with pooled SD

data:  dat.nurse_re$test_score and dat.nurse_re$condition

          pre_score post_score
post_score < 2e-16   -
fu_score   1.5e-14   1.2e-06

P value adjustment method: bonferroni
```

**Bonferroni Explained:**
- Divide p value by # of comparisons; This is your new cut off value
- Adjusts for Type I error

| Greenhouse and Geisser Sphericity Correction | | | |
|---|---|---|---|
| Effect | GGe | P[GG] | P[GG]<.05 |
| Condition | 0.95 | 6.66 e-50 | * |

**Greenhouse Explained:**
- Correction when Sphericity is violated
- GGe value varies between 1/(k–1) to 1.
  - k # of conditions
- Closer to 1 the better

## Discussion

- Significant changes in Knowledge & Attitudes overall & between each condition pair
- Psychometrics needed for the Knowledge & Attitudes Total Score
- Analysis of other Domains especially behaviors would provide further support
- Follow-up Analysis: multiple regression using demographic data as predictors of score